



REFERENCE SAMPLE PROGRAM

**METHOD OF TEST FOR  
SAND EQUIVALENT**

2017 PROFICIENCY TEST RESULTS

---

**State of California Department of Transportation**  
Division of Engineering Services  
Materials Engineering and Testing Services  
Office of Roadway Materials Testing  
5900 Folsom Blvd., MS #5  
Sacramento, California 95819-4612

**August 16, 2017**

## TABLE OF CONTENTS

<b>1.0</b>	<b>Overview .....</b>	<b>2</b>
<b>2.0</b>	<b>Analysis of Test Results .....</b>	<b>3</b>
<b>2.1</b>	<b>EVALUATION CRITERIA .....</b>	<b>3</b>
<b>2.2</b>	<b>INITIAL TEST .....</b>	<b>3</b>
<b>2.3</b>	<b>RETEST .....</b>	<b>4</b>
<b>2.4</b>	<b>COMBINED RESULTS .....</b>	<b>5</b>
<b>2.5</b>	<b>OBSERVATIONS.....</b>	<b>5</b>
<b>3.0</b>	<b>Summary.....</b>	<b>5</b>
<b>4.0</b>	<b>References.....</b>	<b>6</b>

## LIST OF TABLES

<b>Table 1: Evaluation Criteria.....</b>	<b>3</b>
<b>Table 2: Labs and Test Results Considered as Outliers for Sand Equivalent.....</b>	<b>3</b>
<b>Table 3: Summary of Initial Test Results .....</b>	<b>4</b>
<b>Table 4: Summary of Retest Results .....</b>	<b>4</b>
<b>Table 5: Summary of IA Witness Test Results .....</b>	<b>5</b>
<b>Table 6: Summary of Combined Test Results.....</b>	<b>5</b>

### **Appendix A – Test Results from Initial Test**

### **Appendix B – Test Results from Retest**

### **Appendix C – Test Results from IA Witness Test**

## **REFERENCE SAMPLE PROGRAM**

### **SAND EQUIVALENT**

#### **2017 PROFICIENCY TEST RESULTS**

##### **1.0 OVERVIEW**

In August 2017, Caltrans Reference Sample Program (RSP) sent out announcements inviting laboratories currently enrolled in the Caltrans RSP to participate in proficiency testing. Laboratory proficiency testing is a requirement of the Caltrans Independent Assurance (IA) Program mandated by FHWA. Proficiency testing ensures that laboratories performing tests on roadway materials for Caltrans and federally funded projects are qualified.

The test method used for this proficiency testing was California Test (CT) 217 “Method of Test for Sand Equivalent.” The purpose of this proficiency test is to ensure that laboratories performing CT 217 are proficient in conducting this test, including using correct test equipment and providing accurate test results to Caltrans RSP.

A uniform proficiency sample was prepared in the state References Sample Laboratory located at 5900 Folsom Blvd, Sacramento, CA. The aggregate used originated from a single source to maintain material uniformity. The sample was designed with a specific standard target value determined prior to sample distribution.

This test provides an indication of how well asphalt binder bonds with coarse aggregate. Cleanness value is used to determine aggregate quality on treated permeable bases, concrete pavement, and structure concrete. This test assigns an empirical value to the amount of clay-size particles clinging to the coarse aggregate. If necessary, a minimum cleanness value may be specified in order not to exceed a tolerable amount of clay-size particles in aggregate. Excessive clay-size particles coat the aggregate surface and prevent the asphalt binder from bonding. Improper bonding impacts HMA mix stability and may lead to moisture damage and stripping in HMA pavements.

The mass used for the CT 217 samples was  $1000 \pm 10$  grams passing the #4 sieve.

The initial round of participating labs that responded to the announcement letter was 344 laboratories, including private, local agencies, and state laboratories.

## 2.0 ANALYSIS OF TEST RESULTS

### 2.1 EVALUATION CRITERIA

Results were evaluated using a statistical evaluation system in which the mean (X) and standard deviation (s) were calculated. A rating score was then applied to the test results based on the criteria shown in Table 1. A test result with a score of 3 or greater was considered an acceptable result. A test result with a score of 2 or less was considered unacceptable and a retest was required.

**Table 1: Evaluation Criteria**

Test Result	Rating	Interpretation of Results	Acceptance
$X \pm 1.0s$	5	Very Good	Acceptable
$X \pm 1.5s$	4	Good	
$X \pm 2.0s$	3	Fair	
$X \pm 2.5s$	2	Poor	Unacceptable
$X \pm 3.0s$	1	Very Poor	

### 2.2 INITIAL TEST

A total of 344 laboratories participated in the initial test. Laboratories were excluded from the statistical analysis for one of the following reasons. (1) Test results not submitted by the prescribed deadline. However, laboratories that submitted late results were ultimately scored using the initial analysis results as reference. (2) Results were not submitted on the data sheet issued. Analysis for outliers in accordance with ASTM E 178 was conducted for each set of samples. These outliers were summarized in Table 2. The initial statistical analysis is summarized in Table 3.

**Table 2: Labs and Test Results Considered as Outliers for Sand Equivalent**

CT 217				
Sample	# of Labs	Initial Failures		Passing Labs
		Failure Count (Lab ID)	Outlier Count (Lab ID)	
CT 217	344	40, 80, 87, 90, 97, 137, 142, 149, 151, 201, 208, 226, 234, 263, 268, 293, 300, 301, 308, 313, 314, 329, 341, 356, 361, 369, 394, 520, 540, 593, 616, 617, 635 (33)	90, 97, 151, 226, 234, 293, 301, 308, 361, 369, 520 (11)	311

After excluding the outliers, the average and standard deviation were recalculated for each sample set to determine the score for each of the remaining 333 laboratories. The analysis results are presented in Table 3. Detailed test results are provided in Appendix A.

**Table 3: Summary of Initial Test Results**

Item	# of Laboratories	# of Outliers	# of Laboratories (used in analysis)	Number of Labs Achieved Score of				
				5	4	3	2	1
CT 217	344	11	333	270	27	14	6	16
% of Total				81	8	4	2	5

### 2.3 RETEST

Retest samples were sent to laboratories whose test results were considered as outliers and to laboratories that scored a rating of 2 and below. In the initial analysis, 33 laboratories did not achieve acceptable ratings. These laboratories were listed in Table 2. In November 2017, these 33 laboratories were provided with a 2<sup>nd</sup> sample to conduct retest. The retest results were evaluated based on the initial statistical analysis results. The retest summary is presented in Table 4. Detailed retest results and scores are provided in Appendix B. Laboratory #142 and #593 did not achieve acceptable rating for the retest. A third sample will be sent to laboratory #142 and #593 for a 2<sup>nd</sup> retest which will be witnessed by Caltrans (IA) Independence Assurance staff. A Summary of witness test results is provided in Table 5.

**Table 4: Summary of Retest Results**

Item	# of Laboratories	# of Failures	# of Laboratories (passed)	Number of Labs Achieved Score of				
				5	4	3	2	1
CT 217	33	2	31	20	8	3	1	1
% of Total				61	24	9	3	3

**Table 5: Summary of IA Witness Test Results**

Item	# of Laboratories	# of Failures	# of Laboratories (passed)	Number of Labs Achieved Score of				
				5	4	3	2	1
CT 217	2	-	2	1	0	1	0	0
% of Total				50	0	50	0	0

## 2.4 COMBINED RESULTS

A total of 344 laboratories participated in the reference sample program, 33 laboratories participated in both the initial test and the retest with two laboratories failing to attain an acceptable result. Laboratory #142 and #593 failed to achieve acceptable results which will be later witnessed by Caltrans IA personnel. The final combined score that includes the initial test, retest, and IA witness test are scored in Table 6.

**Table 6: Summary of Combined Test Results**

Item	# of Laboratories	# of Failures	# of Laboratories (passed)	Number of Labs Achieved Score of				
				5	4	3	2	1
CT 217	344	-	344	291	35	18	0	0
% of Total				85	10	5	0	0

## 2.5 OBSERVATIONS

During the initial testing, 33 laboratories failed the sand equivalent proficiency test. Consequently, retests for these 33 laboratories were required to ensure that laboratories are correctly following the test methods and using the correct equipment. The retest samples provided laboratories corrective measures to obtain acceptable results. The corrective measures include determining reasons for failures, aid in resolving any issues related to the equipment, test procedure and sample. Once the retest were completed and results were evaluated, two laboratories failed to achieve acceptable results. Laboratory # 142 and #593 were provided with a sample to perform a 2<sup>nd</sup> re-test with Caltrans IA staff present to observe. Caltrans IA staff then provided observation notes and test results for Laboratory #142 and #593.

## 3.0 SUMMARY

In the initial round of testing, 344 laboratories participated. Out of the 344 participants 33 laboratories failed the initial test. The failure constitutes laboratories whose results were considered as outliers and those with results below a score rating of 3. Laboratories that failed to

submit their references sample results were not considered in the statistical analysis. Samples were provided to the 33 failed laboratories for a retest, and 31 laboratories passed with satisfactory results. The 2 laboratories that failed the 1<sup>st</sup> retest were later given a 2<sup>nd</sup> retest with Caltrans IA staff present the laboratories achieved an acceptable rating.

## **4.0 REFERENCES**

California Test Method 217, “Method of Test for Evaluating Cleanness of Coarse Aggregate”

ASTM E 178 – 80, “Standard Practice for Dealing with Outlying Observations”

Caltrans Independent Assurance Manual, dated July 2005.

## **APPENDIX – A**

### **Test Results from Initial Test**

<b>CTID #</b>	<b>SE Average</b>	<b>Rating</b>
1	46.67	4
2	44.67	5
3	38.00	5
5	38.67	5
6	37.67	5
7	37.33	5
9	37.00	5
11	37.66	5
12	42.67	5
15	35.00	5
16	35.33	5
17	36.33	5
18	35.33	5
19	37.33	5
20	42.18	5
22	34.33	5
23	34.33	5
24	36.67	5
26	39.33	5
27	38.00	5
28	43.67	5
29	43.00	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
31	37.33	5
32	32.67	4
38	36.66	5
39	42.79	5
*40	57.00	1
41	35.67	5
43	36.66	5
46	38.00	5
47	42.33	5
48	44.66	5
49	41.00	5
50	35.00	5
52	37.33	5
53	41.67	5
55	34.96	5
56	36.00	5
57	36.67	5
58	42.33	5
59	36.00	5
62	37.00	5
64	35.67	5
65	35.00	5
66	36.66	5
67	38.00	5
68	41.00	5
69	37.33	5
70	39.33	5
71	36.00	5
73	36.00	5
74	38.00	5
75	42.00	5
76	31.33	4
79	40.00	5
*80	55.67	1
81	35.00	5
83	36.00	5
84	35.00	5
*87	55.33	1
88	38.67	5



*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
*90	58.00	1
92	33.33	4
93	39.00	5
94	39.33	5
96	38.67	5
*97	69.66	1
98	38.00	5
99	38.33	5
100	38.33	5
103	31.66	4
104	33.66	4
110	36.00	5
112	31.00	3
113	34.33	5
114	37.00	5
116	32.33	4
117	39.00	5
118	35.00	5
120	45.00	4
122	45.66	4
123	43.33	5
125	35.33	5
128	38.33	5
131	39.67	5
132	33.33	4
135	36.00	5
*137	56.33	1
139	36.67	5
140	34.00	5
142	53.00	2
143	37.67	5
144	37.33	5
145	31.66	4
146	36.66	5
147	34.67	5
*149	57.67	1
*151	64.67	1
154	37.00	5
156	39.00	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
158	40.66	5
160	36.00	5
161	39.66	5
164	35.33	5
166	37.33	5
170	38.00	5
173	38.67	5
177	38.67	5
182	36.33	5
183	45.66	4
184	40.67	5
191	42.67	5
192	41.00	5
193	38.33	5
195	36.67	5
196	45.67	4
197	40.33	5
*201	56.67	1
207	35.33	5
208	52.14	2
209	42.00	5
210	37.00	5
213	38.00	5
214	37.00	5
215	42.66	5
216	40.00	5
219	38.33	5
221	37.66	5
223	39.67	5
*226	60.33	1
233	39.33	5
*234	59.00	1
237	39.67	5
238	35.00	5
239	32.00	4
241	39.00	5
242	36.67	5
244	42.67	5
245	36.00	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
246	35.00	5
248	34.66	5
249	40.33	5
250	34.67	5
252	39.33	5
253	38.33	5
255	35.00	5
256	34.67	5
257	47.67	3
*263	54.33	1
264	42.00	5
265	37.66	5
266	35.33	5
*268	57.00	1
269	35.33	5
271	37.00	5
273	38.67	5
278	41.00	5
281	34.00	5
282	35.33	5
283	36.33	5
284	35.33	5
285	36.33	5
286	35.00	5
288	48.33	3
289	38.33	5
290	44.33	5
291	39.33	5
*293	59.67	1
296	34.33	5
297	40.00	5
*300	53.67	1
*301	63.00	1
302	35.67	5
303	38.00	5
304	36.66	5
*308	58.00	1
309	35.00	5
310	39.33	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
311	40.00	5
312	40.67	5
313	56.00	1
314	56.00	1
316	36.67	5
318	34.88	5
319	40.67	5
321	39.00	5
322	37.67	5
326	43.33	5
329	51.57	2
330	36.66	5
331	35.67	5
332	36.33	5
333	41.67	5
334	36.00	5
337	49.33	3
338	35.33	5
340	38.33	5
341	54.67	1
342	35.67	5
344	44.66	5
345	41.33	5
346	36.00	5
347	44.67	5
348	34	5
349	37.67	5
351	39.00	5
352	33.00	4
353	38.00	5
354	41.00	5
356	51.67	2
359	38.33	5
360	46.00	4
*361	58.00	1
362	49.00	3
364	37.67	5
366	38.67	5
367	31.66	4

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
*369	87.00	1
370	33.33	4
372	45.66	4
377	37.67	5
379	35.67	5
381	43.67	5
382	35.04	5
385	38.31	5
387	46.00	4
388	36.00	5
389	49.33	3
393	34.67	5
394	53.33	1
395	36.33	5
396	34.67	5
398	37.37	5
399	38.00	5
400	37.33	5
401	35.33	5
402	38.00	5
403	37.00	5
405	39.00	5
407	41.00	5
412	37.33	5
413	40.00	5
416	37.00	5
417	38.66	5
418	49.67	3
419	38.33	5
420	34.33	5
422	47.66	3
423	37.33	5
426	39.00	5
428	39.00	5
432	45.00	4
438	40.33	5
441	35.67	5
442	39.66	5
443	41.33	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
445	41.33	5
447	40.33	5
448	41.00	5
449	47.74	3
451	50.00	3
455	36.73	5
457	36.00	5
461	41.73	5
464	37.00	5
469	36.67	5
476	37.66	5
478	38.00	5
479	47.33	4
480	40.76	5
482	47.67	3
483	34.33	5
485	36.00	5
491	39.33	5
492	38.33	5
493	36.33	5
495	39.66	5
501	35.33	5
508	39.67	5
509	48.00	3
511	38.33	5
513	39.67	5
*520	67.00	1
521	43.67	5
522	45.33	4
524	38.66	5
527	42.33	5
533	37.63	5
534	35.00	5
535	36.00	5
536	36.00	5
538	36.33	5
540	56.33	1
541	37.00	5
543	34.33	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
550	38.00	5
551	39.67	5
552	44.66	5
562	44.33	5
565	32.33	4
569	38.00	5
574	40.00	5
576	40.67	5
580	39.00	5
583	29.33	3
584	39.00	5
586	32.33	4
589	35.33	5
590	37.00	5
*593	50.66	2
595	38.33	5
596	36.00	5
600	38.84	5
603	34.23	5
604	37.00	5
608	38.33	5
611	44.00	5
612	37.33	5
614	35.33	5
615	38.33	5
*616	56.00	1
*617	56.00	1
628	33.67	4
634	40.00	5
*635	26.00	2
636	37.67	5
637	43.00	5
639	34.00	5
642	35.33	5
643	38.66	5
644	40.33	5
645	36.00	5
646	40.00	5
647	37.66	5

*RSP Sand Equivalent  
Proficiency Test Results  
Office of Roadway Materials Testing*

CTID #	SE Average	Rating
648	40.00	5
649	38.33	5
652	37.33	5
654	31.57	4
1703	37.00	5
1704	39.00	5
1705	41.00	5
1707	37.00	5
1708	48.17	3
1710	43.67	5

**Legend:**

*
---

**Unacceptable Score**



**APPENDIX - B**  
**Test Results from Retest**

CTID#	SE Average	Rating
40	35.67	5
80	40.67	5
87	38.00	5
90	44.00	4
97	36.00	5
137	40.88	5
*142	49.00	2
149	34.00	4
151	40.00	5
201	33.33	3
208	41.97	5
226	40.67	5
234	37.00	5
263	42.00	5
268	34.33	4
293	44.33	4
300	34.00	4
301	38.74	5
308	44.67	4
313	38.00	5
314	38.00	5
329	46.00	3
341	35.00	4
356	38.00	5
361	45.66	3
369	39.00	5
394	35.67	5
520	44.33	4
540	37.33	5
*593	60.00	1
616	38.33	5
617	36.56	5
635	38.00	5

**Legend:**

\*

**Unacceptable Score**

**APPENDIX - C**  
**Test Results from IA Witness Test**

CTID#	SE Average	Rating
142	41.00	5
593	48.33	3